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SOVIET BLOC INTERNATIONAL
GEOPHYSICAL YEAR INFORMATION

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INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION - 1959

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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM --
SOVIET-BLOC ACTIVITIES

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I. GENERAL

Soviet Film on IGY Investigations

The Moscow Studios of Popular Science Films has issued a full-length motion picture in color on the investigations conducted under the program of the International Geophysical Year. The film is called "Alert," after the signal dispatched to participating scientists throughout the world notifying them of periods of intensified observations. ("Alert," review by G. Mironov; Moscow, Promyshlennno-Ekonomicheskaya Gazeta, 20 May 59, p 4)

Miniature Mass Spectrometer Described

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A miniature radio-frequency mass spectrometer called the RMS-M, which is 100 millimeters in height and 24 millimeters in diameter, is described. It has a resolving power of 16. It is stated that "the RMS-M may be applied in those situations in which its small size, low weight, and comparatively 'poor' vacuum of 10^{-3} millimeters of mercury are required." ("Miniature Radio-Frequency Mass Spectrometer," by Ye. F. Doil'nitsyn, A. I. Trubetskoy, and M. Ya. Shcherbakova, Institute of Geology and Geophysics, Siberian Affiliate, Academy of Sciences USSR; Moscow, Pribery i Tekhnika Eksperimenta, No 2, Mar-Apr 59, pp 82-82.)

II. ROCKETS AND ARTIFICIAL EARTH SATELLITES

"Artificial Sodium Comet" Used to Track Mehta

"In observing artificial earth satellites, great difficulties arise in connection with the weak luminosity of the satellite and the low velocity of its motion against a background of stars. Observations are even more complicated in the photographing of cosmic rockets which are located at a distance of hundreds of thousands of kilometers from the Earth at the moment they are photographed. For example, a rocket at a distance of 400,000 kilometers from the Earth will have a stellar magnitude equal to 15, while the second Soviet satellite, at a distance of 400 kilometers, had a stellar magnitude of approximately zero, i.e., the rocket in this case represents an object which is weaker than the satellite by a factor of 10^6 . (The brightness of two stars which differ by one stellar magnitude differs by a factor of 2.512.) In firing rockets in the direction of the moon, we must deal with an extremely bright background created by the moon. In using telescopes with a power of about 1:3, this background limits the exposure time to a few seconds, since the fog on the photographic plate would become

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very dense with longer exposures. It is, therefore, necessary to have an instrument of sufficient diameter to take stars up to a magnitude of 15 or 16 with an exposure of about one second. (If the diameter of the image of the star is constant, the penetrating power of the telescope, i.e., its limiting stellar magnitude, depends only on the diameter of the objective.) However, the number of such instruments in the whole world does not exceed ten.

"To be able to carry out optical measurements of the coordinates, it would be necessary to develop a method of optical observation of the Soviet cosmic rocket, based on the increase in its brightness.

"It is evident that the use of any kind of pulse lamp is completely excluded because of the great weight of the power supply. The plan of the American scientist, Singer, to explode an atomic bomb on the rocket also does not stand up to criticism since we would observe an extremely brief flash, the photographing of which would be almost impossible. It would make sense to explode an atomic bomb only if the rocket struck the Moon, since a large amount of luminous material would be produced. However, the optical effect would not be great even in an explosion on the surface of the moon because of the absence of an atmosphere on the Moon.

"Schemes in which the use of solar radiation is proposed are much more attractive. This idea takes various forms. It is possible, for example, to eject a balloon from the rocket which will have a sufficiently large diameter and a good reflecting surface, thus increasing the possibility of observing it. Such a balloon is inflated by compressed gas and, thus, keeps its spherical shape even upon being struck by a meteorite. This idea was proposed for the American Earth satellites which are small in size and difficult to observe. It is also possible to eject a cloud of small scattering particles from the rocket. However, in all these ideas, the increase in brightness is not great.

"A more effective scattering of an entirely different nature may be observed in nature. We are speaking of the mechanism of resonance fluorescence. The phenomenon consists essentially of gas atoms absorbing quanta of a definite frequency from the solar radiation striking them and emitting energy at this frequency. Each atom here may be compared to a vibrator which is set swinging by the incident wave with the frequency of its characteristic oscillations.

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"The scattering coefficient at resonance fluorescence is very great and attains a maximum value in comparison with all values of the coefficients for other processes of scattering light. The luminosity of comets is basically explained by this mechanism. Resonance bands of molecules of C_2 , CO, CN and others are found in the heads of comets, as well as D_1 and D_2 resonance lines of atomic sodium. The luminosity of the gaseous tails of comets is also explained by the resonance scattering solar radiation by CO^+ and N_2^+ molecules. For a comet of average size, the concentration of radiating molecules is equal to only several molecules per cubic centimeter. From this we find that the mass of the radiating gas in the head of a comet does not exceed 100 tons. This is an extremely small quantity! Indeed, such a quantity of gas produces an object of about the third stellar magnitude at a distance of 150 million kilometers. To obtain the same brightness for a distance of 400,000 kilometers, only about 5 kilograms of the appropriate gas would be necessary.

The idea of increasing the brightness in a rocket by ejecting gas from it is now clear. Sodium appears to be the most acceptable in this respect. It is easily vaporized and gives an intense resonance doublet in the yellow portion of the spectrum, with an average wave length of 5893 angstroms. One may consider that each sodium atom located at a distance of 150 million kilometers from the sun will, each second, emit in all directions 0.7 quanta of light in the D resonance lines. Only one gram of sodium containing, by the way $2.5 \cdot 10^{22}$ atoms will give us a stellar magnitude of 14 at a distance of 100,000 kilometers. As a one-kilogram cloud, its stellar magnitude is close to 6.

"Sodium is vaporized by mixing it with thermium, which is ignited by a special device at a predetermined moment. Even if a part of the sodium should be ejected in the form of molecules during the vaporization process or ejected as particles of molten metal and only 10-15 percent transformed into atomic sodium, the cloud evolved by one kilogram of metallic sodium would give a gain in brightness of at least 1,000, in comparison with direct observations on the rocket. It is necessary to use powerful cameras of relatively small diameter to photograph the cloud form. Such apparatus may easily be installed throughout the territory where the rocket can be observed at the moment of the flash.

"Attention should be drawn to one feature of the artificial comet method. The sodium cloud yields monochromatic radiation. By applying a narrow-band light filter, the brightness of the Moon's halo may be considerably diminished, while the sodium radiation falls on the photographic plate almost undiminished. Domestic multilayer interference light filters with a transmission band of 30 angstroms are used in the observations. These filters gave a gain of 50, and the exposure could be increased to one minute for a distance from the Moon of several degrees of arc. In addition to the photographic equipment, instruments with electron-optical converters were used. By using these, the exposure time could be shortened by a factor of 15. Instruments of similar penetrating power are equivalent to a meter telescope, although the same objective is used in these as in photographic cameras.

"To verify all of the theoretical considerations, it was decided to test the method under high-vacuum conditions. To do this, a sodium vaporizer was mounted on a high altitude geophysical rocket. It was fired to an altitude of 440 kilometers on 19 September 1958 at 4 o'clock in the morning. At the time of the experiment, the altitude of the Earth's umbra in the zenith was equal to approximately 300 kilometers, and the cloud of sodium vapor which was formed was irradiated by the Sun's rays and glowed brightly in the D lines. The cloud was photographed at all stages of its development from observation stations on the Earth.

"In addition, a photoelectric photometer was used to measure the surface brightness at the center of the cloud. Subsequent analysis of the photographs supported all preliminary calculations.

"This experiment was extremely valuable for geophysics. The use of the photographs of the cloud made it possible to determine the density of the Earth's atmosphere at an altitude of 440 kilometers.

"The relationship observed between the velocity of the expanding cloud and the time (inversely proportional to the square root of the time) indicates that, at the time of the experiment, a diffusion of the sodium atoms occurred in the Earth's atmosphere. It is theoretically possible to calculate how the concentration of sodium atoms at the center of the cloud varies with time, starting from a given value of the diffusion coefficient, which is a function only of the density of the atmosphere. The same relationship may be obtained from observations, and the more probable value of the concentration of atmospheric atoms may be found by comparing them.

"The most natural assumption is that oxygen is completely dissociated and comprises the main part of the atmosphere at these altitudes. Further, assuming that the temperature at this altitude is about 15,000 degrees, as is now generally believed, we find that the concentration of air atoms is equal to $2.5 \cdot 10^8$ particles per cubic centimeter, which gives a value of the density of $6.7 \cdot 10^{-15}$ grams per cubic centimeter. (It should be noted that the values found here depend very little on the assumed value of the temperature, since the temperature enters into the formula for the diffusion coefficient in the degree one half.)

"The value obtained for the density agrees well with the results of a determination of the density of the upper atmosphere on the basis of the slowing down of the artificial satellite. The diffusion method of determining the density of the upper atmosphere is very useful. Actually, it is the average density over several revolutions which is determined by observing the slowing down of satellites. It has now been established that the Earth's atmosphere undergoes daily, seasonal, and latitudinal variations in density. The diffusion method gives a value of concentration of atmospheric atoms for a fully determined altitude at a known moment, and at a

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specific point. It may be used for a wide range of altitudes, from 200 to 600 kilometers. Below 200 kilometers, the density of the atmosphere is so high that the diffusion process will continue for several hours, and since the experiment must be conducted at night, we will not be able to observe the process completely. Above 600 kilometers diffusion will not occur, since the sodium atoms experience so few collisions that their path length becomes commensurate with the dimensions of the cloud (the path length in the present case was equal to about 10 kilometers.)

"After the tests had been successfully conducted, the equipment for creating the artificial comet was mounted on the first Soviet cosmic rocket. On 3 January, at 1556 hours 20 seconds, the vaporizer was set off. Since expansion occurred in a vacuum, naturally the initial expansion velocity (around 2 kilometers per second) was constant, and in 20 seconds, the cloud became visible against the background of the sky. In this time, it had reached a size of about 100 kilometers. It is clearly impossible to create a cloud of such gigantic dimensions from any kind of solid sphere.

"The coordinates of the cloud were tied to the stars with great accuracy, and it was then possible to calculate the coordinates of the rocket. These are important in figuring its trajectory.

"The artificial-rocket method has already proved its effectiveness. However, it can be considerably improved and can make it possible to observe the flight of a future cosmic ship. We hope that this time is near."

("Artificial Sodium Comet," by V. L. Kurt, State Astronomical Institute imeni P. K. Shternberg, Moscow; Moscow, Priroda, No 5, May 59, pp 74-76)

Solar Sails for Cosmic Flights

The fact that the rays of sunlight falling on a body exert a pressure upon it has been known by scientists for over 70 years. The extremely small force exerted by the pressure of light, claims an article in Sovetskaya Aviatsiya, was first measured in a very cleverly conducted experiment by P. N. Lebedev, the noted Soviet physicist.

The use of this force for propelling space craft in the future has interested many foreign specialists, says the article, in connection with the development of rocket techniques and the advent of interplanetary flights. According to authors of the proposed designs for these cosmic craft capable of using the pressure of light, the article states, the sails must be spread after the space craft is injected into orbit with the use of rocket motors. For the pressure to be appreciable, the sail area would have to be very large. It has been calculated that for the movement in cosmic space of one-gram of payload, a sail area of 180 square meters would be needed.

The advantages cited include the small amount of reserve fuel which would have to be carried on board the craft. ("Solar Sails"; Moscow, Sovetskaya Aviatsiya, 24 May 59, p 4)

III. UPPER ATMOSPHERE

Aurorae on Venus Noted by Soviet Scientist

A little more than 6 years ago, on 18 March 1953, the noted Soviet scientist N. A. Kozyrev, Doctor of Physicomathematical Sciences, using the 50-inch reflector at the Crimean Astrophysical Observatory, obtained, for the first time in astronomical practice, unique photographs of the spectrum of Venus' dark side. The pictures showed that this side of Venus was illuminated similarly to the night sky of the Earth.

These conclusions by the Soviet scientist have now been confirmed, states a TASS report, by Gordon Newkirk, an American astronomer at the University of Colorado's observatory. Newkirk reports the results of similar observations of Venus that he conducted which confirm the existence of a band of luminescence of the night sky in the spectrum of this planet.

In an interview with a TASS correspondent, Kozyrev said: "When CPYRGHT we observe the Moon in the form of a sickle, it is also possible to see all of its darkened side. This phenomenon, in astronomy, is called 'Ashen Light.' The darkened side of the Moon is illuminated by the Earth reflecting the light of the Sun.

"Venus passes through the same phases in changing its form as the Moon. When this planet is observed in the form of a sickle, astronomers note the appearance of the darkened side of Venus, that is, the Ashen Light. But, as is known, there is no satellite near this planet. Therefore, the nature of Venus' Ashen Light must be different. It should be pointed out that this light is sometimes unnoticeable, while sometimes it can be seen very well. Therefore, the opinion has been formed by astronomers that this phenomenon is an optical illusion.

"On the basis of spectral investigations, I succeeded in establishing that the Ashen Light can be explained by the luminescence of the outer layers of Venus' atmosphere similar to how the Night sky of the Earth is illuminated. Photographs of the spectrum of Venus' darkened side I succeeded in making showed that this side is actually illuminated similarly to the night sky of the Earth. But the illumination appeared to be 50 times brighter than the Earth's at night. It is interesting to note that no signs of oxygen were detected as a result of analyses of the photograph. It is known that the principal illumination on the Earth is due to the presence of oxygen. On Venus, the illumination of nitrogen molecules, as we have in aurorae, was detected. A number of bands of unknown origin were also discovered.

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Apparently aurorae occurred on Venus at the moment of the photographing. Thus, the actuality of Venus' Ashen Light and its connection with an ionospheric process was established." (Aurorae on Venus"; Moscow, Sovetskaya Aviatsiya, 26 May 59, p 4)

New Book on Use of Solar Energy

A new, 60-page, illustrated book, Ispol'zovaniye Solnechnoy Energii (Use of Solar Energy), by K. L. Bayev and V. A. Shishakov, issued by the Publishing House of the Academy of Sciences USSR, tells of the practical application of the colossal energy of solar radiation, called the energy of the future, in industry and in everyday living.

The reader can learn of the present state of helioengineering and the prospects of its development and is acquainted with different solar apparatus converting radiant energy into heat. The authors describe both the simplest low-temperature devices, as well as the most complex high-temperature concentrators of solar energy, the solar furnaces, indispensable means for conducting investigations in the field of high temperatures and reactive techniques and for obtaining high-purity materials. Also shown is how the energy of the Sun will be used for power. ("Review of New Books"; Moscow, Priroda, No 4, Apr 59, p 123)

IV. METEOROLOGY

Soviets Claim Lead in Field of Heliogeophysics

Prof M. S. Eygenson, L'vov State University imeni Ivan Franko, writing in a Priroda article, claims Soviet work in heliogeophysics occupies a leading place in world science. He says that Soviet achievements in this field were almost completely unknown in the West until very recently and that foreign scientists became really acquainted for about the first time with Soviet results in this work through a special report delivered at the Tenth International Astronomical Congress held in Moscow in 1958.

Prof Eygenson, in his article titled "Sun, Weather, and Climate," gives certain information on investigations of the large meteorological role played by the physical processes continuously arising on the Sun. These changes have a purely solar origin and are in no way connected with the movements of our planet.

The Sun's total radiation outside the Earth can be considered as a rigid constant. Physical changes on the Sun, i.e., solar activity, must, therefore, be expressed, first of all, in the redistribution of energy in the electromagnetic wave spectrum of the Sun and in the increase, from the "norm," of the ejection of fast particles (corpuscles).

The upper atmosphere of the Earth is the first to encounter solar radiation. Therefore, the appearance of the geoactivity (the capability of physical action on a given geosphere) of solar photons and corpuscles can be expected in an analysis of the physical processes arising in the upper layers of the atmosphere.

The nature of the physical links between the upper and lower atmosphere, while not sufficiently studied in the past, has been described as a system of vertical circulation, which means that deviations from the normal state of the lower (or upper) layers can be transported upwards (or downward).

Active solar radiation is undoubtedly absorbed (wholly or partly) in the upper atmosphere of the Earth. Starting with this, L. R. Rakipova showed that sun-caused changes of the thermohydrodynamic regimen of the upper atmosphere can be carried into the troposphere (lower atmosphere) and cause marked changes in its normal state.

It is still not fully clear whether some processes in the troposphere are caused by the displacement of the layers or whether solar activity can, in some more direct form, affect meteorological processes.

Eygenson claims the discovery of a connection of the total coefficient of transparency of the Earth's atmosphere with the corpuscular activity of the Sun. Thus, he says, there is no doubt that solar activity can have an effect on the troposphere, as does radiation alone.

Numerous empirical solar-meteorological connections have already been established. However, only in the postwar years was the extremely close connection of the character of the total circulation of the troposphere with solar activity, which very strongly determines the intensity and type of total atmospheric circulation, definitely established.

The partial solar dependence of the over-all planetary circulation of air, water, and ice masses makes it possible, in a new way, to formulate and solve in principal the important scientific and practical problem of geophysical prognosis. This geophysical prognosis, thanks to the discovery of very close heliogeophysical ties, can, henceforth, be considered as the terrestrial consequence of the prognosis of solar activity.

Solar activity can appear only as a major or minor disturbance of the intrinsic regularities of the development of a given geosphere or a combination of neighboring interacting geospheres. Hence, the wider the given hydrometeorological process develops in space and time, other conditions being equal, the more clearly the role of cosmic effects, among them the solar factor, can emerge.

On the other hand, the role of the solar factor in the processes of small time-space scales can be more or less forced into the background by purely intraterrestrial hydrometeorological interrelations and local physical-geographic conditions. Therefore, at the present time in particular, the application of heliogeophysical methods to hydrometeorology still appears to be more successful in the field of very-long-range forecasts, i.e., in processes measured by years and long periods of time. In the field of long-range forecasting, in processes measured by several days and more, heliogeophysics has made only its first steps.

Several of the latest Soviet studies showed the existence of a number of such large hydrometeorological processes in which local influences have a completely secondary significance in comparison with the circulatory factor. Thus, for example, N. I. Tyabin found that a tie exists between the repetitiousness of meridional type, total atmospheric circulation, and the mean temperature of the water (to a depth of 50 meters) along the Kol'sk meridian in the Barents Sea, with a correlation coefficient of 0.98.

The degree of relationship between the indexes of total atmospheric circulation and the iciness of the offshore seas of the Soviet Arctic is also very high, according to V. S. Antonov and N. I. Tyabin. Present, also, are some other, almost functional, connections between the total circulation and certain large meteorological and hydrological processes (for example, the level of the Pacific Ocean and the level of the Caspian Sea).

Thus, on the one hand, there is an extremely close link between certain large hydrometeorological processes and the total circulation of the atmosphere. But, on the other hand, as already mentioned, there exists a no less close connection between solar activity and the total circulation of the atmosphere. Thus, it follows that in these large hydrometeorological process, solar activity has a decided importance.

Actually, N. I. Tyabin found that an extremely close (almost functional) connection (equal to 0.99) exists between solar activity and the above-mentioned temperature of the North Caspian current. An almost similar close connection exists between solar activity and the iciness of the Barents Sea (~ 0.94) and also between the solar activity and the average, many-year level of the ocean at a number of points on the western and eastern shores of the Atlantic.

So high a degree of relationship for certain solar-hydrometeorological links makes a geophysical prognosis on a heliogeophysical base completely justifiable scientifically. Forecasts of solar activity inside its 11-year cycle are rather successfully made at present. Forecasts of solar activity inside its secular cycle are already beginning to be developed at present. Eygenson, himself, gave a rough outline of a forecast for the future development of the current secular cycle of solar activity.

Having a secular prognosis of the future variation of solar activity, on the one hand, and knowing the heliogeophysical ties, on the other, it is possible to attempt giving a secular prognosis of the development of a number of large geophysical processes.

The fall in the level of the Caspian Sea, which has been almost 3 meters since 1930, is considered a reflection of the development of the total circulatory air-water situation. The level was shown to be a unique gauge of the intensity of the total circulation of the Earth's atmosphere by recent studies made by N. A. Belinsky and G. P. Kalinin. Eygenson says that on the basis of the above-mentioned facts, this level must, at the same time, be, in the final analysis, heliogeophysically caused.

In 1952, Eygenson showed that the present low state of the waters of the Caspian Sea were caused by the high secular level of solar activity. Now, in 1959, there already is the possibility of giving a preliminary forecast of the time of the future minimum of the current secular cycle of solar activity, and, consequently, it is also possible, at the same time, to outline a forecast for the water mass of the Caspian Sea and the Volga-Kama reservoirs.

According to this forecast, this water mass must, in the next decade, rise considerably. This means that if the water consumption in the artificial Volga-Kama seas cannot absorb all of the expected increase of the corresponding water mass, then the present low state of the waters of the Caspian Sea will change to a high state in the years from 1980-1990.

Of no less importance is the problem of ensuring continuous navigation conditions on the Great Northern Sea Route, which was established in the past 20-30 years. Climatic conditions were favorable for shipping during this time. This period also saw a gradual warming of the Arctic. The reason for the warming trend in the first 10 years of the century was laid to solar activity by Eygenson. L. S. Berg, the great Soviet geographer, showed that the low degree of ice formation in the Arctic and the low level of the Caspian Sea are only linked on the side of one and the same physico-geographic process. Now, in connection with the attainment in 1957-1958 by solar activity of its current secular maximum, the situation, before long (i.e. in the course of the next several decades), must be reversed. If this prognosis is true, then for the polar seas specifically, it means a future decline in their ice conditions.

At present, says Eygenson, the first attempts at long-range meteorological forecasts on a heliogeophysical basis have already been made. While such forecasts were made previously for almost purely research purposes, at present, the use of solar hydrometeorological forecasts has also been started for practical purposes. According to preliminary data, considering the factor of solar activity has notably contributed to the improvement of long-range synoptic prognoses. ("Sun, Weather, and Climate," by Prof M. S. Eygenson; Moscow, Priroda, No 4, Apr 59, pp 83-85)

Study on Nacreous Cloud Observations

A comparison of observations, by meteorologists of several countries, of mother-of-pearl clouds over Norway has shown that an increase of the usual amount of ozone over the area coincides with an increase in the number of occurrences of these nacreous clouds. The maxima of these two processes coincide with the occurrence over Northern Europe of high-altitude winter stratospheric jet streams, which are responsible for the variation of the amount of ozone and for the formation of the nacreous clouds.

A comparison of weather charts and searchlight soundings made in the Moscow area and in the Caucasus (Driving, A. Ya., et al, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 5, 1958; Ibid, No 3, 1958) has shown that, when maps of the absolute topography of the 200- and 300-million surfaces indicate a possible rising of air masses in the region of a high frontal zone, but corresponding aerological data show a cooling with height over the entire layer, aerosols observed in the stratosphere apparently represent condensation products. The formation of condensation products in the lower layers of the stratosphere (upper tropopause) presupposes a dynamic cooling of the atmosphere during the rising of air masses.

In Europe, the weather which accompanies nacreous clouds is distinguished by the existence of a warm, high anticyclone and, to the north of it, deep cyclones of an Arctic front with great temperature contrasts and, consequently, with considerable kinetic energy. Such cyclones are vertically thick and determine the character of the weather up to great heights. An analysis of the distribution of temperature in the troposphere and lower stratosphere for Europe in the winter shows that frontal zones, like zones of large temperature gradients, are encountered in the lower stratosphere, but also often in the troposphere. The jet stream connected structurally with the high frontal zone, usually located at a height of 9-12 kilometers, is characterized by the development of strong vertical currents which differ in sign on both sides of the stream axis. Observations in the Moscow area established the fact that jet streams are accompanied by a variety of clouds: by several

usual, as well as unusual, forms of cirrus and cirrostratus clouds located in bands or in no particular order; by groups of cirrocumulus clouds accompanied by cirrus clouds and thin high stratus clouds; by high stratus lenticular clouds in groups or individually in well defined form; and even by high wavy cumulus clouds. It is also known that well expressed regions of increasing and decreasing temperature at different heights in the troposphere and in the lower layers of the stratosphere are connected with cyclones and anticyclones and are, even though not entirely, very nearly contiguous, indicating the close relationship of processes in the troposphere and in the lower stratosphere (Zubyan, G. D., Sinoptiko-aerologicheskoye issledovaniye atmosferykh frontov [Synopto-aerological Investigation of Atmospheric Fronts], Leningrad 1955).

A stratospheric cloud at an altitude of 21-29 kilometers represents a condition which is natural not only to Scandinavian countries and Alaska in winter; under similar meteorological conditions (and with sufficiently intense cyclonic activity), these high clouds can be observed in other latitudes and at other times of the year. ("On Nacreous Clouds," by A. Ya. Drving, Institute of the Physics of the Atmosphere, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 3, Mar 59, pp 410-421)

V. SEISMOLOGY

Chinese Adopt New Earthquake Intensity Scale

A new scale of seismic intensity with characteristic Chinese indexes is compiled chiefly on the basis of field observations and abundant historical materials. References are made to some instrumental data, foreign seismic reports, and other scales of seismic intensity.

The new scale consists of 12 degrees, each corresponding approximately to the same degree in other 12-degree scales. The scale is set up in table form and consists of four main columns describing the conditions of houses and structures, residual phenomena in the ground, changes of surface and subsoil water conditions, and other phenomena. In an effort to present clear and concise descriptions, main types of houses and the degree of destruction to buildings are classified. The type of masonry houses, similar to those in European countries and built in large numbers in recent years in China, is taken as a standard in linking Western and Chinese houses. Residual phenomena in the ground are greatly influenced by soil, underground water, and topographical conditions. While formal classification is not carried out, these phenomena, as well as their environmental circumstances, are clearly described. Indefinite criteria, such as human feelings, are used only when there are no other suitable indexes. Owing to the lack of instrumental data, quantitative expressions such as ground displacements or accelerations are not included in the scale. ("A New Scale of Seismic Intensity Adapted to the Conditions in Chinese Territories," by Hsieh Yu-show, Institute of Geophysics and Meteorology, Academia Sinica; Peiping, Acta Geophysical Sinica, Vol VI, No 1 Jun 57, pp 35-48)

New Soviet Instrument for Measuring Soil Displacements During Blasting Operations

A new instrument, rugged and simple in operation, has been built in the Institute of the Physics of the Earth Academy of Sciences USSR for measuring oscillations of the soil and engineering installations during blasting operations. The instrument, called a "vibrograph for large [soil] displacements," despite its own small size, makes it possible to measure displacements in the presence of oscillations of the soil reaching tens of centimeters and makes it possible to study explosion effects at close distances heretofore inaccessible for investigations. The new instrument, it is said, will find wide application in blasting operations, the building of hydraulic installations, etc. (Moscow, Promyshlennno-Ekonomicheskaya Gazeta, 13 May 59, p 4)

VI. ARCTIC AND ANTARCTIC

Observations During Flight Over Antarctica

At the end of September 1958, members of the Soviet Antarctic Expedition made a flight over Antarctica from Mirnyy to the Australian station Mawson. The flight had several aims, i. e., to conduct observations along the coast, to study the interior mountainous region south of Olaf-Prydz Bay on the return flight, and to pay a return visit to the Australian station at Mawson.

The flight started on 28 September, at 0530 hours local time. The IL-12 plane was piloted by V. M. Perov. From Mirnyy, the course was west-southwest in the direction of the Australian station Davis. The plane flew over Cape Filchner and Krause Point. Fifteen minutes later, Gaussberg was visible on the horizon, and in 20 more minutes, the plane passed the traverse of the mountain, 25 kilometers south of Gaussberg. Then followed Leopold and Astrid Coast, bordering on the West Ice Shelf.

The plane flew above the coast, south of the West Ice Shelf. The eastern part of this ice shelf is fed by the Philippi Glacier, flowing down from the antarctic slope along a small trough. On current maps, the trough is represented by a curve of the coastline to the west, between Gaussberg and Cape Penck. The antarctic slope in the area of the West Ice Shelf has been photographed from the air, and the trough of the Philippi Glacier has been traced as far as 67 degrees S, with bench marks of 500 meters. The Soviet plane flew further south and was able to trace the trough as far as 67 15 S, with bench marks of 800 meters.

The plane then flew towards the point where the western edge of the ice shelf joins the coast of Antarctica. Between the longitudes of 87 45 and 86 50, the plane passed over the highest part of the slope along the flight route, with altitude marks of 820-830 meters. After this, an irregular decrease in the elevation of the terrain began. At the 84th meridian, the elevations of 600-700 meters came to an end, and the coastal slope quickly descended to 100 meters.

At 0716 hours local time, the plane reached the eastern shore of Olaf-Prydz Bay, at the point of coordinates 67 56 S and 81 27 E. Along the entire route up to this point, an undulating, gradually rising surface was visible in the direction of the continent. It was interesting to trace the direction of the main sastrugi, corresponding to the prevailing direction of the wind. From the region of Gaussberg to approximately the 84th meridian, the sastrugi had a southeasterly direction, normal for the antarctic slope; however, beginning with the 83rd meridian, the direction of the sastrugi became northeasterly, i. e., they are oriented along the eastern shore of Olaf-Prydz Bay and correspond to the prevailing wind in the lower 2-3 kilometer layer of the atmosphere, as recorded by

pilot-balloon observations at Davis Station. On the day of the flight, according to pilot-balloon observations at Mirnyy, east winds were recorded up to an altitude of 1,500 meters; at higher altitudes, they were replaced by south and southwest winds, and at Davis Station, northeast winds were observed up to an altitude of 2,000 meters.

In the area where the plane approached Olaf-Prydz Bay, the fast ice was up to 10 kilometers wide. Polynyas were visible beyond the fast ice. The coast is "active," i. e., it produces a large number of icebergs.

At 0730 hours Mirnyy time (one hour ahead of local time), a dark island was visible at the horizon, and soon after that, one could distinguish an oasis with a large number of frozen lakes. The oasis has the shape of an irregular triangle, extending from northeast to southwest over a distance of 25 kilometers. The surface of this oasis resembles Bungee Oasis, except that the granite elevations here are lower and more sloping. Individual cliffs protrude near the coast. The Australian station Davis is located in the southwest portion of the oasis, on the coast, at 68 34 S and 77 56 E.

Olaf-Prydz Bay was covered with greyish-white hummocked ice alternating with open water areas covered with young ice. There were no icebergs.

Continuing the flight to Mawson, the plane approached the shore more closely. Near Lars Christensen Coast, as far as the Gustav Bull Mountains, there was no fast ice; large areas of open water and young ice were visible, as well as many icebergs. The convection currents above the water caused slight bumping of the plane. The Gustav Bull Mountains represent outcrops of basic rocks, partly snow-covered. Beyond these mountains to the south, a rising slope was visible, and on the horizon, the isolated Peak Hjerck [not further identified] could be distinguished. The fast ice begins west of the Gustav Bull Mountains; the sastrugi on the fast ice run in the usual southeasterly direction. Finally, mountains and islands appeared on the horizon; this was the area of the station Mawson.

From Mawson, the flight route led in a general southeasterly direction, and then a turn was made to the northeast, past Mount Brown and Gaussberg and back to Mirnyy.

The flight over the area south of Olaf-Prydz Bay was of considerable interest, since it was intended to find out whether there actually existed any mountain ranges south of the 70th parallel. Such mountains, which had been seen in 1947, had been tentatively indicated on the map. One of the mountain ranges was shown as existing between the 65th and 70th meridians E, and the other approximately near the 80th meridian. The existence of these mountains or elevations would have helped to determine the position of the valley, representing the continental extension of Olaf-Prydz Bay. This was of great interest. It so happened that during the flight to the

pole of relative inaccessibility, on 23 December 1957, in which Ye. I. Tolstikov, G. I. Golyshev, and V. K. Boborykin took part, a wide valley was discovered, extending from southeast to northwest. The plane crossed this valley between the 65th and 80th meridians E and between the 72nd and 78th parallels S. A subsequent processing of the observations showed that the bottom of the valley on this route is located near 74 30 and 73 00, with an absolute elevation of 2,170 meters.

During the second flight to the region of the pole of relative inaccessibility, on 27 February 1958, in which V. A. Bugayev and Kh. Ya. Zakiyev participated, the upper reaches of this valley were discovered about 200 kilometers southwest of station Sovetskaya, where the lowest elevation of this profile of Antarctica, equaling 3,380 meters, was determined at the point of coordinates 77 20 and 80 00. It was natural to assume that in its lower reaches this valley would run into the Olaf-Prydz Bay. It was necessary to take measurements of the elevations and to construct a profile of the terrain.

In Mawson, the Soviet scientists were shown the results of aerial photography made during the past 2-3 years. The aerial photographs and several flights made by the Australians into the interior of the continent produced interesting results. It turned out that the Amery Ice Shelf penetrates deeply into the continent. It begins at 72 degrees S and is over 40 kilometers long. The area of the iceshelf (about 63,000 square kilometers) makes it the fourth largest among the ice shelves of Antarctica.

South of the 72nd parallel, a very large glacier was discovered, which is 450 kilometers long and has several tributaries; it was named Lambert Glacier. The glacier begins at the 60th meridian and flows first to the east, slightly south of the 73rd parallel. At the 67th meridian, the glacier turns sharply to the north and, in the form of a large, 50-60 kilometer wide river of ice, it discharges into the Amery Ice shelf. The approximate area of the Lambert Glacier is 19,500 square kilometers. Numerous mountain peaks and short mountain ranges rise along the sides of the glacier. Photographs of individual sections show a typical picture of a mountain glacier. This area has not yet been fully explored. The Soviet flight route crossed the upper part of the Amery Ice Shelf and then proceeded to the northeast over a little known region. Observations for altitude computations were made at many points.

To the southeast of Mawson, the surface of the ice cap was seen rising abruptly, at the rate of one kilometer per 200 kilometers. Further on, after a flight of 22 kilometers, the surface elevation rose to 715 meters, corresponding to an inclination angle of 2.3 percent. Then the grade became less steep, with an inclination of 0.5 percent as far as 186 kilometers from Mawson, at which point the elevation reaches 1,560 meters; the descent to the Amery Ice Shelf begins from here.

In the immediate vicinity of the station Mawson, to the right of the flight route, the Masson and David ranges were visible, with snow-free, rocky peaks. At the point 68 55 and 65 13, the plane passed the traverse of an isolated mountain, which remained at a distance of 30 kilometers to the right of the flight route. On the Australian map, this was named Depot Peak. After a flight of 60 kilometers, individual rocky peaks were seen on the right, and after 50 more kilometers, the Prince Charles Range had its beginning, also on the right. The range approached the flight route at an acute angle. First, the plane flew alongside the range, and then above it.

Gradually, the snow-covered mountains were replaced by snow-free peaks. Glaciers were encountered frequently; sometimes they looked like narrow rivers with a clearly distinguishable channel. Beginning at 70 30, i. e., 300 kilometers from the coast on a direct line, the plane flew for several tens of kilometers over a region which might be called an interior oasis. Here, the mountain peaks come closer together, forming an area almost completely free of snow. The space between the mountains was occupied by level areas and winding strips of blue ice, resembling frozen mountain lakes and streams. One of the lakes was crescent-shaped, about 26 kilometers long. Its snow-free ice surface makes it possible to land the plane on wheels. In exploring this region, the Soviet scientists knew that, in Antarctica, the snow-free areas of glacier ice, when seen from the air, are frequently thought to be mountain lakes. However, the lake scenery in this case made a different impression.

Traces of irregular freezing of water were seen on the ice areas. Here and there, patches of dark, apparently young, ice were visible, such as appear when polynyas have recently been frozen. One could also observe frozen brooks connecting the lakes. The general direction of the Prince Charles mountain range is from southeast to northwest.

At a distance of 448 kilometers from Mawson, at the intersection of the 71st parallel and 69th meridian, the large horizontal surface of the Amery Ice Shelf appeared below the plane, with an elevation of about 320 meters above sea level. In approaching the northwest edge of the ice shelf, the steeply rising shores of the Antarctic ice cap were clearly visible, surrounding the ice shelf in a semicircle, and were covered with numerous clearly defined crevasses.

At the point 71 44 and 70 30, the plane flew over the shoreline and, after 17 kilometers, made a turn to the northeast. The mountain peaks surrounding the upper part of the Amery Ice Shelf could be observed from the east and south up to the point where the plane turned. In addition, in a southerly direction as far as the horizon, mountain ranges and individual peaks were clearly visible in the interior of the continent, located on both sides of Lambert Glacier. The weather was clear, and visibility was over 100 kilometers.

From the point of the turn, over a distance of 200 kilometers, the surface of Antarctica rises to about 2,000 meters, forming the right slope of the above-mentioned interior antarctic valley. The angle of inclination here is between 1.1 and 0.5 percent. Further, over a distance of 450 kilometers, the elevation of the surface changes relatively little, with the highest mark of 2,150 meters at the point 69 55 S and 81 25 E. However, the surface is not uniform. At a distance of 285 kilometers from the turning point of the plane, an undulating relief and crevasses in the ice were encountered. From this point, it is not more than 50 kilometers in a western direction to the region where, according to the navigation chart, there are "mountains, observed in 1947," and other maps of Antarctica indicate a mountainous region discovered in 1939 by Lincoln Ellsworth.

However, no mountains are visible, even though visibility was good, from an altitude of 400 meters above the surface of Antarctica, for 70-80 kilometers in all directions. By the way, Mount Brown, which rises only 300 meters above the surface of the ice, was visible at the horizon from a distance of 100 kilometers. At the 312th kilometer past the turning point, the terrain again became undulating, and crevasses extended from southeast to northwest. After 60 kilometers of flight in a northeasterly direction, the plane crossed the 80th meridian in the region of the allegedly existing mountains; however, nothing was observed except a slight lowering of the terrain. The earlier-mentioned highest point in this profile was indicated as being 67 kilometers further on. Again no mountains were to be seen. This was the second instance in which mountains previously reported by explorers disappeared from the map. In a similar way, the range which had been shown to exist near the 72nd parallel, west of station Pionerskaya, has been removed from the map. It is impossible to assume that during the past 10 or 20 years, some of the lower mountain peaks, even if they did exist, were covered with a heavy layer of firm and snow. The annual accumulation of snow on the slope of the antarctic ice cap, caused by snow drifts from the interior regions of Antarctica, measures only 1-2 meters; during this process, the snow settles, and the ice flows downward, thereby compensating for the increase in height of the slope. Finally, during the present epoch, as proved by various facts, the ice cap of Antarctica is decreasing rather than increasing. Apparently, during previous flights some individual alto-cumulus clouds of purplish color, which occur sometimes above Antarctica in otherwise cloudless weather, had been mistaken for remote mountain peaks.

In completing the survey of the surface of Antarctica along the flight route, it was determined that the coastal antarctic slope begins within a distance of 2 1/4 kilometers from the coast near Gaussberg or 20-30 kilometers before reaching Mount Brown. At first, the angle of inclination is an average of 0.5 percent, and during the last 40 kilometers, as is usual in the coastal areas, it increases to 2 percent. The profile along the route of the flight presents evidence of the fact that the antarctic valley, beginning near the station Sovetskaya, extends as far as the coast and opens into Olaf-Prydz Bay. The positions of structure contours (isohyps), indicated as 500, 1,000, and 2,000 on the published maps, are very inaccurate. ("Flights Over Antarctica," by V. A. Bugayev and Ye. I. Tolstikov; Moscow, Priroda, No 4, Apr 59, pp 63-69)

Polish Antarctic Station A. B. Dobrowolski

In the fall of 1958, representatives of the Academy of Sciences USSR offered Poland one of the Soviet Antarctic stations -- the Oasis of Bunger. The offer has been gratefully accepted. This station has the advantage of not being covered the year round with ice, and it lies on the same meridian as the Polish-Vietnam meteorological station Cha-pa.

It was decided to use this station for measurements of gravimetry, terrestrial magnetism, eventually seismism, the abundance of CO₂ in the air, and the radioactivity of atmospheric precipitations.

The first stay in the Antarctic was scheduled to be only 2 weeks, but during the following year, [1959] when the scientific staff is expected to be more complete, the expedition will stay for about 15 months, and the research will involve ionospheric and more complete meteorological observations.

The Soviets made transportation facilities available to the expedition -- ship, airplanes, and helicopters. The head of the expedition was Wojciech Krzeminski, engineer. Zbigniew Zabek and Janusz Sledzinski, engineers, conducted gravimetric measurements. Maciej Zalweski, engineer, measured to CO₂ content of the air and the radioactivity of precipitations. Czeslaw Centkiewicz was assigned to meteorology. Finally, the author himself had duties of housekeeping and of reporting on the expedition.

Prof Stefan Zbigniew Rozycki, of the Polish Academy of Sciences, was dispatched for the official acceptance of the station from Soviet authorities.

The trip started on the Soviet ship the Mikhail Kalinin, which had left Leningrad in the first days of January and stopped at Gdynia to take the Polish expedition aboard. The itinerary during the run southward included a stop at Dakar, for refueling, and thereafter at Capetown before sailing for the Antarctic. The trail through the ice was broken by the Soviet icebreaker "Ob'." On 22 January, an airplane from Mirny (Antarctica) took the whole expedition to Mirny, stopping there for only 20 minutes before continuing to the Scott Glacier. The rest of the trip was made by helicopter, to the point of destination -- the "Oasis" station. Here, Boris Imeryakov the chief of the station; Wyacheslav Yakovlev, the radio officer; and Aleksander Morozov, the mechanic, were present to meet the Polish delegation.

The Bunker "Oasis" made a good impression by its display of colors, the blue, green, or grey of its lakes contrasting with the white monotony of surrounding ice.

The next day, a Soviet delegation from Mirny was announced: Eugene Tolstikov, chief of the III Antarctic Expedition; Aleksander Dralkin, head of the IV Antarctic Expedition; Victor Bugayev, chief of the aerometric group; and Vladimir Lebedev, the scientific secretary. An hour after the arrival of the guests, Professor Rozycki and Eugene Tolstikov signed the contract turning over the station to the Polish Antarctic Expedition. The station was named "Antoni Dobrowolski," in honor of the Polish glaciologist. The Polish flag was hoisted above the station.

The stay had to be shortened to 9 days, unexpectedly, because the icebreaker Ob, scheduled to escort the Kalinin, had to make a rush rescue of a Belgian party marooned on the ice. Nevertheless, the Polish expedition succeeded in completing its preliminary work. A part of the food and equipment was left for the expedition scheduled to arrive during next fall [1959] for a stay of 15 months.

Bad weather delayed the removal of personnel and their equipment for 30 hours. Afterwards, the personnel was successfully transferred to the Kalinin, which sailed northward, back to civilization. ("An Oasis Among Glaciers," by Czeslaw Nowicki; Warsaw, Problemy, No 4, 1959, pp 230-237)

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